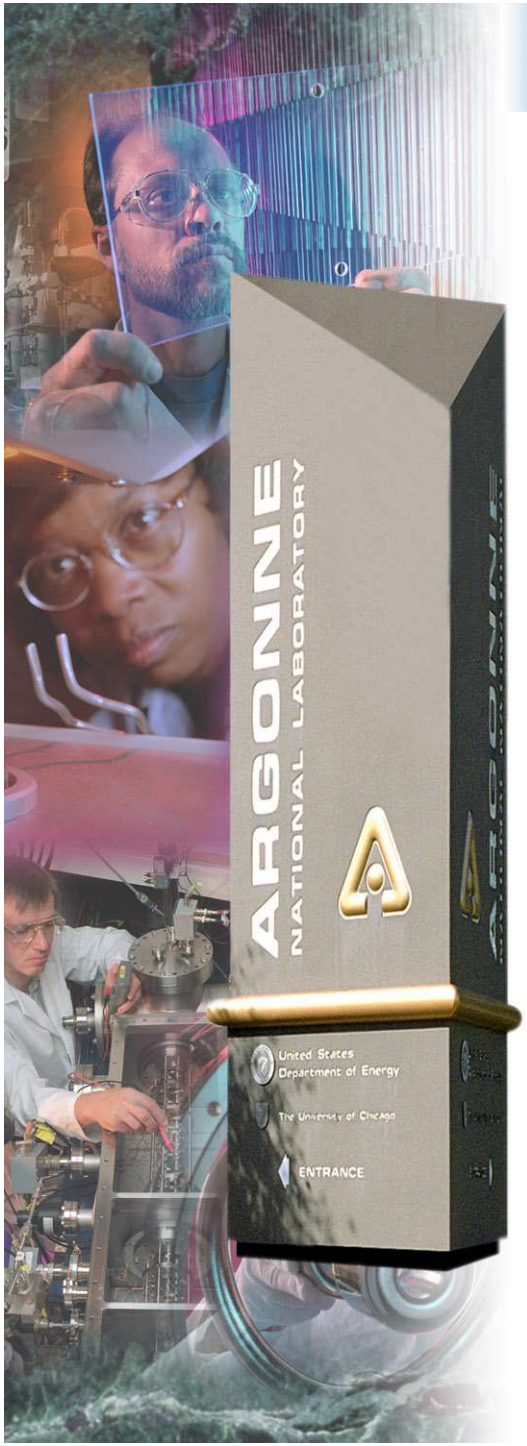


ILC Controls Requirements

Claude Saunders

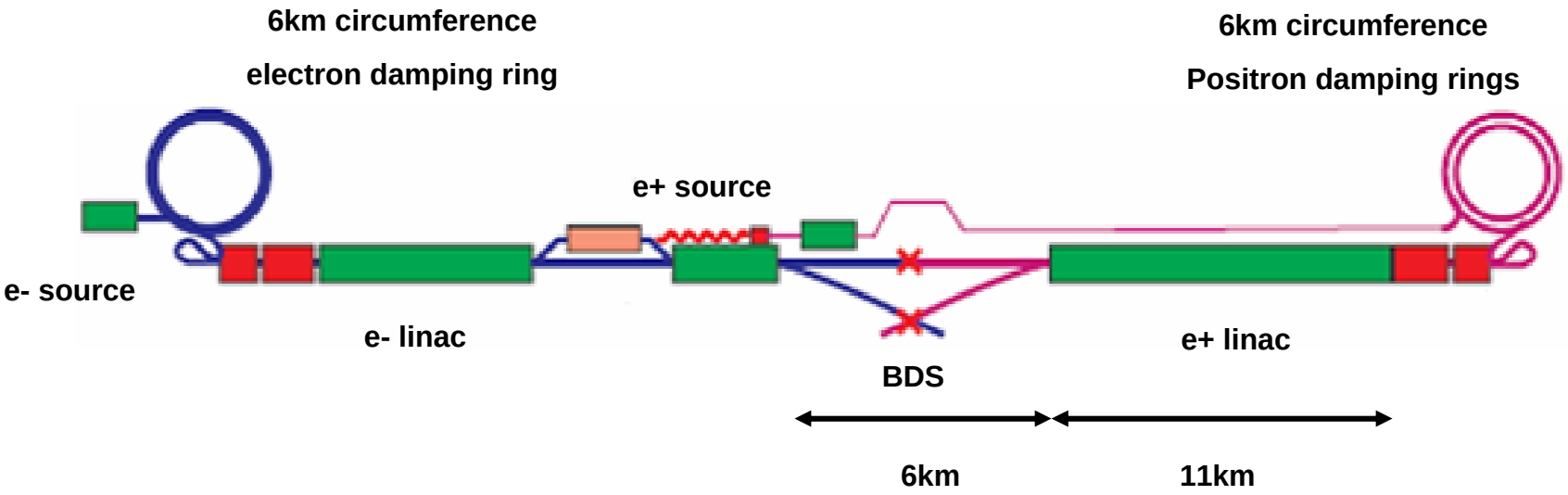
Argonne National Laboratory is managed by
The University of Chicago for the U.S. Department of Energy

Official ILC Website

- www.linearcollider.org (add /wiki for more technical info)

ILC Physical Layout (approximately)

- electron-positron collider
  - 500 GeV, option for 1 TeV



Some Interesting Figures

- 20,000+ superconducting RF cavities
  - 8 per cryomodule, 3 cryomodules per klystron
- 670+ Klystrons
- 17,000+ Magnets (most are individually powered)
- 3,700+ Beam Position Monitors (most are cavity-type)
- 5Hz Pulse-to-Pulse repetition rate
- 2800+ bunches per pulse

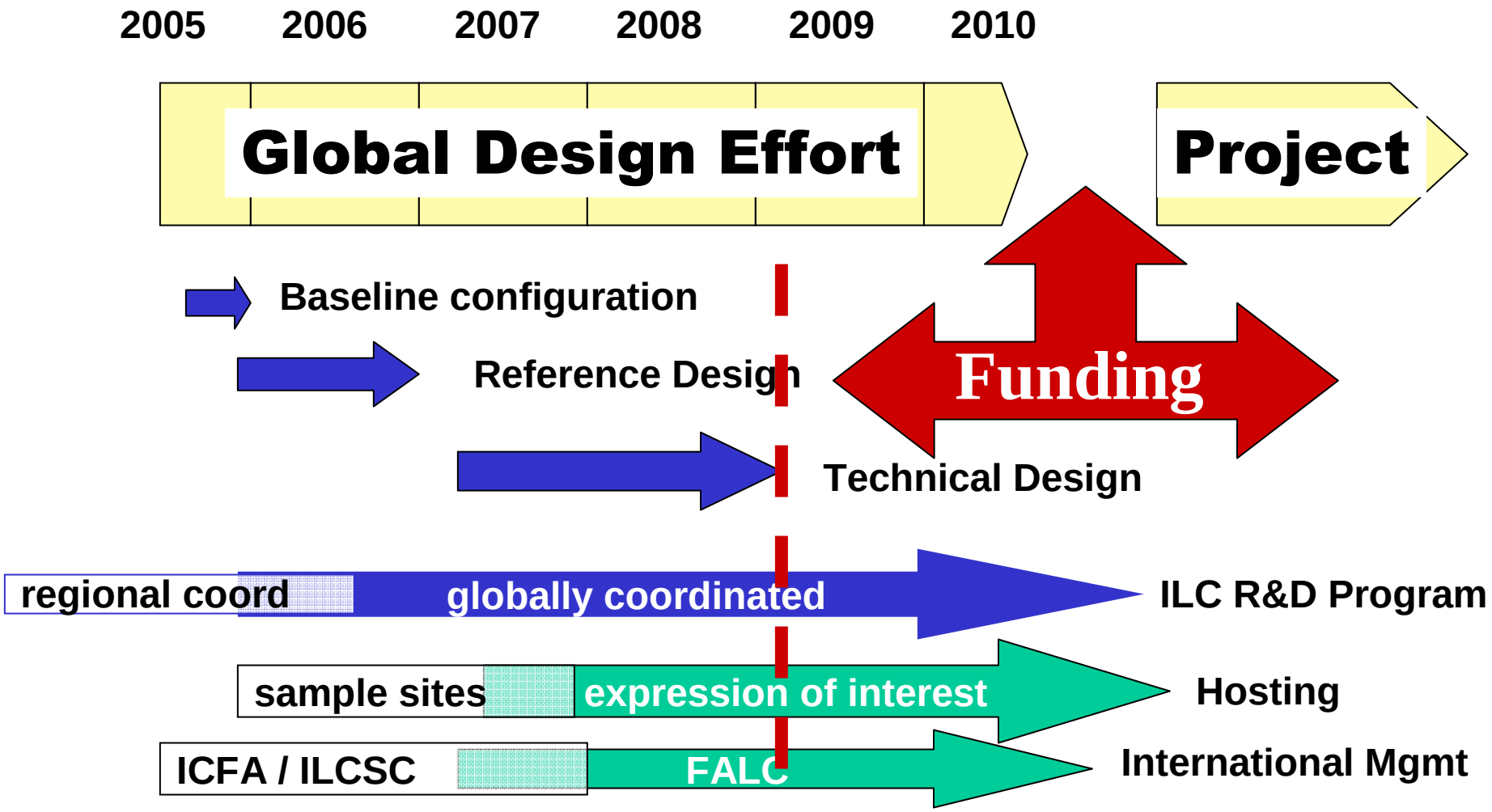
- 3 Regions
  - Americas
  - Europe
  - Asia

Controls Collaboration

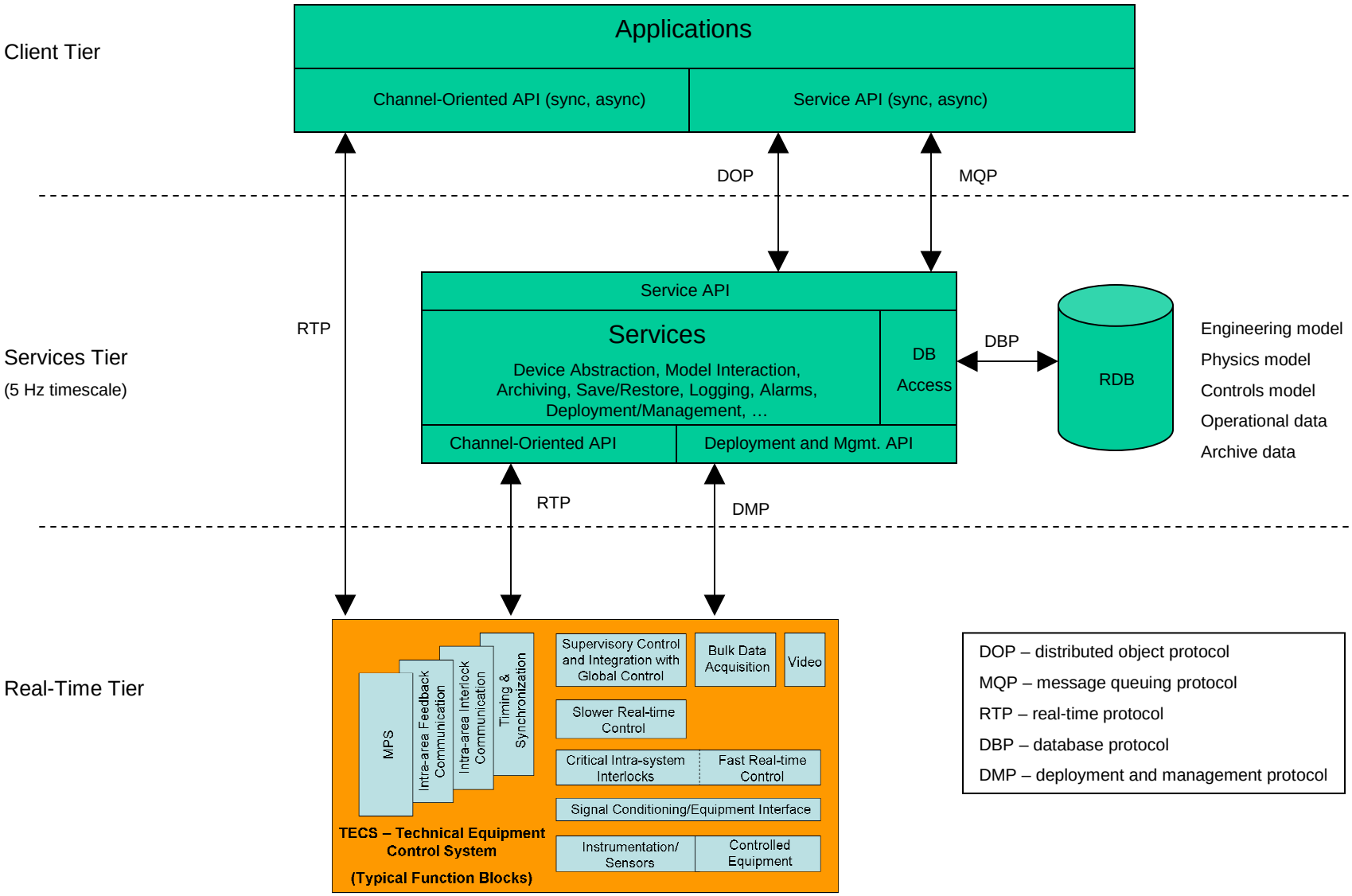
- John Carwardine
- Stefan Simrock
- Shinichiro Michizono

DESY, Argonne National Lab, KEK, Fermilab, SLAC, others?...

ILC Activities



Abbreviated Control System Functional Diagram



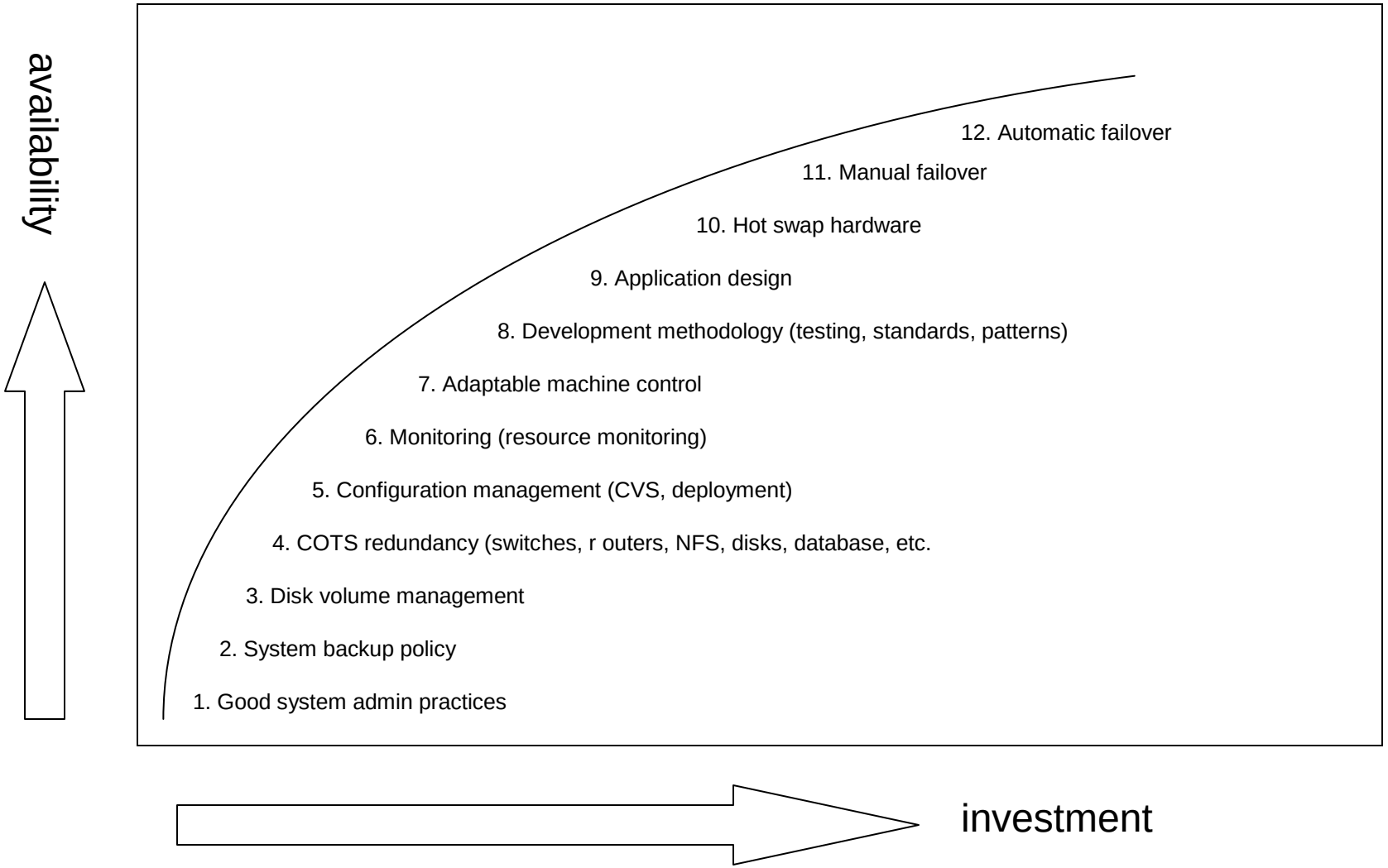
ILC Availability

- Existing High Energy Physics Colliders
  - 60% - 70% available
- Light Sources
  - 95+ % available (APS > 97%)
- Why the discrepancy?
  - Colliders are continually pushed for higher performance, light sources are more steady-state.
    - *Higher power*
    - *Higher rate of software/configuration change.*
  - Collider goal is to maximize integrated luminosity, so generally run until something breaks. Light sources have more scheduled downtime.
- ILC Goal
  - 85+ % available
  - As measured by integrated luminosity

ILC Control System Availability

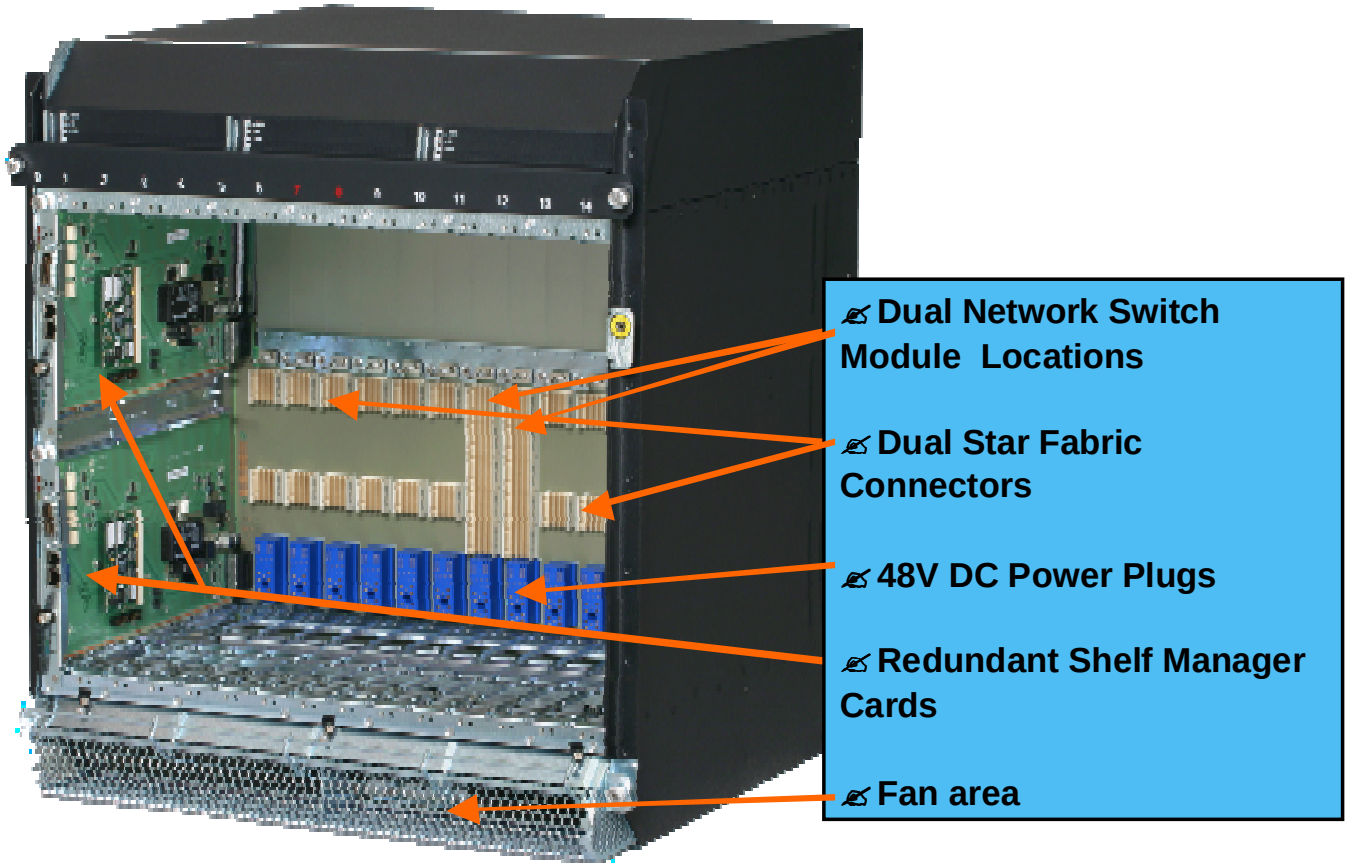
- 99.999% 5-nines requirement
  - not clear what this implies
    - *Don't change any software – but what if needed to increase luminosity?*
    - *We do have scheduled downtime*
    - *Plus downtime due to other trips (opportunity to swap)*
  - Control system typically responsible for 1 – 2% of machine downtime
    - *Agree? Disagree?*
  - Incremental improvement to existing controls may be sufficient

The Availability Index



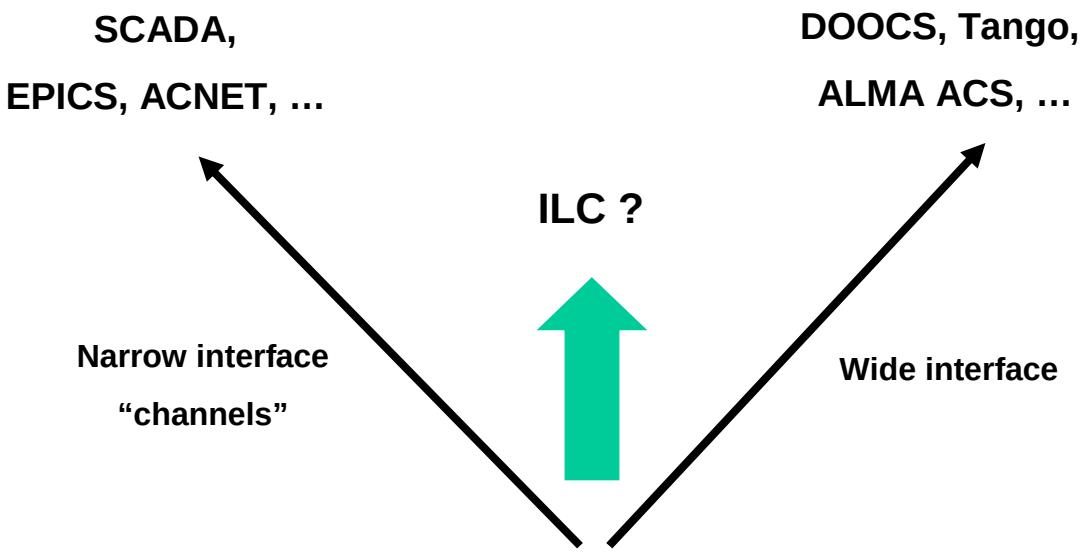
Controls Baseline Configuration - Hardware

- ATCA – Advanced Telecommunications Computing Architecture
- u-TCA – not finalized, so not in baseline for now
- AMC – mezzanine card specification



Controls Baseline Configuration - Software

- No control system decision or commitment made yet
- ILC is certainly a potential customer for EPICS
  - What can be done now with this in mind?



Considerations

- Scale
  - Approximately 2500 shelves (IOCs)
  - Control room 20km away from either end of the machine
  - Overseas remote control room
- Data Acquisition
  - Collecting circular data buffers after a trip
  - Steady-state LLRF and BPM data archiving
- Monitoring
  - A view on the health of every “resource” in the system
- Automated Diagnosis (drive down MTTR)
  - Both pre-emptive and post-mortem

Considerations - continued

- Feedback
  - General 5Hz feedback system (any sensor, any actuator)
  - Fast intra-train feedback
- Configuration Management (everything)
- Security
- Automation
  - Anything that slows down machine startup, either at the beginning of a run or after a trip, impacts integrated luminosity.

Where does EPICS fit in at the moment?

- ILCTA at Fermilab
  - EPICS in use at some test stands, planned for others.
  - Concurrently with other control systems (Geoff Savage's talk)
- Proposed ILC Research and Development Projects
  - Control system "gap analysis"
    - *Select set of candidate control system frameworks.*
    - *Determine the modifications and enhancements necessary to meet ILC requirements.*
  - ATCA evaluation
    - *Port EPICS to ATCA CPU card*
  - High availability research
    - *Control system failure mode analysis (FMEA, FTA, ETA, …)*
    - *Modify EPICS driver and device support to prototype hot swap and possibly failover.*

Some Thoughts on Where EPICS Work is Needed

- Gateway
- Nameserver
- Channel Access
  - Is current version sufficient for DAQ?
  - Maintainable for 20+ years.
  - Alternative pluggable protocols?
- Driver and device support architecture
  - Hot swap, manual failover, automatic failover
- Hierarchical devices
- Support for higher level requirements
  - Think “outside the IOC”
- Auditing
  - Who does what and when?
  - Put-logging